

Utilization of Mirroring Technology in Learning Islamic Religious Education at Muhammadiyah Junior High School Special Program Kottabarat

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Abstract. This study aims to empirically prove that mirroring technology functions as a catalyst that results in an increase in Islamic Religious learning effectiveness and measurable classroom interactivity at Muhammadiyah Junior High School Special Program Kottabarat. Although national trends show the utilization of gadgets (95.2%) by secondary school teachers, the study delves deeper into the implementation of wireless screen mirroring technology, a natural evolution from the use of basic ICT in modern schools to interactive devices. This study uses a qualitative method with a descriptive approach to understand social phenomena in a naturalistic manner. The case study technique was applied specifically to Muhammadiyah Junior High School Special Program Kottabarat to collect rich and in-depth data on the utilization of this program. This approach was chosen to explain the characteristics between the use of mirroring and the Islamic Religious learning process without testing statistical hypotheses. Preliminary findings indicate that the implementation of mirroring at the research site reflects an important transition in the learning ecosystem. In contrast to conventional static projection, the use of interactive device-powered mirroring has proven to have great potential, in line with research showing this technology can increase student information retention by up to 30%. Substantially, the integration of mirroring facilitates the visualization of abstract Islamic Religious materials (such as worship practices and live viewing of Qur'an/Hadith texts), which significantly increases students' motivation to learn and active participation in discussions. These findings confirm that mirroring has succeeded in solving the problem of the gap between the depth of Islamic Religious material and the needs of tech-savvy students' learning styles, thus providing a measurable and replicated Islamic Religious media innovation model. Therefore, this study contributes to the literature by mapping the specific potential of mirroring technology in the context of improving the quality of Islamic Religious Education.

Keywords: *Mirroring Technology, Islamic Religious Education, Learning Interactivity, High School*

INTRODUCTION

The integration of technology in education is increasingly important in improving student learning outcomes and engagement in the 21st century [1], [2]. This shift is driven by the recognition that traditional teaching methods alone may no longer be sufficient to meet the diverse needs of modern learners [3]. Technological advances have opened up new avenues to enhance the educational experience, making learning more accessible, interactive, and effective [4], [5].

One of these technological advances is mirroring technology, which allows the screen display of one device to appear on another screen [6]. These technologies are recognized as having the potential to enhance the educational experience by facilitating real-time information sharing and fostering interactive learning environments [3], [7]. In the context of Islamic Religious Education, the use of mirroring technology offers a unique opportunity to modernize teaching methods and make religious education more attractive to students [8]. Islamic Religious Education has an important role in shaping the moral and spiritual dimensions of students, with the aim of instilling values, ethics, and religious knowledge [9], [10]. However, traditional Islamic Religious teaching methods, which often rely on textual and verbal transmission, may not fully appeal to students born in the digital age. The integration of mirroring technology in Islamic Religious at Muhammadiyah Junior High School Special Program Kottabarat, is a progressive step towards more relevant and interesting religious education.

Educational technology has come a long way over the past few decades, becoming a central component in modern pedagogy. The incorporation of various technological tools aims to create a more interactive,

engaging, and efficient learning environment [8], [11]. In particular, mirroring technology offers an innovative approach to facilitate the real-time sharing of information from one device to another, making it particularly useful in educational settings [12], [13]. The application of this technology in Islamic Religious Education is particularly relevant, given the need to modernize teaching methods to align with contemporary students. In today's rapidly changing educational landscape, the integration of advanced technologies has become the cornerstone of modern pedagogy [14]. Technology tools are not only additional, but integral to creating an interactive, engaging, and efficient learning environment [15], [16]. Among these tools, mirroring technology stands out as an innovative approach that facilitates the real-time sharing of information from one device to another, making it particularly relevant in educational settings [17]. The application of this technology in Islamic Religious Education is significant, given the urgent need to modernize teaching methods to better engage contemporary students [18].

State of the art in this study, recent studies have shown that mirroring technology can improve student engagement and understanding in a variety of subjects [19]. For example, in learning methods, this technology allows teachers to illustrate complex concepts through interactive simulations and visual aids, thereby improving students' understanding [20], [21]. Despite these advances, the integration of mirroring technology in Islamic Religious Education is still limited. There is a significant gap in the literature regarding its application in this field, especially in the context of education in Indonesia. The potential of mirroring technology to change Islamic Religious Education is quite large. Research shows that visual and interactive tools can significantly improve students' retention and understanding of educational materials [22], [23]. Traditional instructional methods, while effective to some extent, may not take advantage of the full spectrum of cognitive engagement that modern technological tools can offer [24]. In Indonesian schools, where the educational landscape is rapidly evolving, there is an urgent need to explore how such technology can be harnessed to improve educational outcomes in religious studies [25], [26]. The existing literature has largely focused on the benefits of technology in secular subjects, with limited attention to its application in religious education [27], [28]. This research aims to bridge this gap by providing empirical evidence on the effectiveness of mirroring technology in Islamic Religious Education [29], [30], [31]

The study examined not only direct educational outcomes but also the broader impact on student motivation and engagement. Advances in educational technology over the past few decades have led to significant increases in student engagement and learning outcomes across a wide range of subjects [32]. Mirroring technology, in particular, has emerged as a valuable tool to improve classroom interaction and facilitate real-time information sharing [33]. By allowing teachers to display their device's screen content on a larger screen, the technology allows for a more dynamic and interactive learning environment [34]. Studies have shown that the use of mirroring technology can improve student engagement, understanding complex concepts, and better information retention [35]. For example, in subjects such as math and science, teachers can use mirroring technology to demonstrate experiments, solve problems step by step, and provide visual explanations that aid in understanding [36], [37]. These benefits have been well documented in the literature, highlighting the potential of mirroring technology to transform traditional teaching methods [38]. However, despite these positive results, the application of mirroring technology in Islamic Religious Education is still not explored [39].

Islamic Religious unique cultural and educational context presents challenges and opportunities to integrate modern technology [40], [41]. While traditional Islamic Religious teaching methods rely heavily on textual and verbal transmission, there is a growing recognition of the need to adapt to the learning preferences of today's students [42]. The Indonesian context, in particular, offers a unique setting for exploring the potential of mirroring technology in Islamic Religious [43]. As a country with a rich cultural heritage and a strong emphasis on religious education, Indonesia faces the challenge of balancing traditional teaching methods with the demands of modern education [44]. The integration of mirroring technology in Islamic Religious can provide a valuable solution to these challenges, offering a way to improve student engagement and learning outcomes while maintaining the core values and teachings of the subject [45]. The novelty of this research fills the gap by focusing specifically on the effectiveness of mirroring technology in Islamic Religious Education, providing insights that can be used to improve teaching strategies in this area. The novelty of this research lies in the emphasis on areas of study that are culturally significant and require modernization [46]. By examining the practicality and impact of the use of mirroring technology in Islamic Religious, this study makes a valuable contribution to the educational technology literature and the field of religious education [47].

The application of mirroring technology in Islamic Religious Education is especially new because it addresses a dual need: the need for the integration of technology in the classroom and the need to make religious education more attractive to modern students [48]. In doing so, this study not only highlights the potential of technology to improve educational outcomes but also shows how traditional subjects can benefit from modern teaching tools [49]. Through a case study of Muhammadiyah Junior High School Special

Program Kottabarat, with a single case, this research aims to provide empirical evidence on the benefits and challenges associated with the use of mirroring technology in real-world educational settings. These findings are expected to inform future practices and policies, encouraging wider adoption of technology in religious education. In addition to addressing the gaps that exist in the literature, this research contributes to the field of educational technology by providing a detailed analysis of the implementation and impact of mirroring technology in Islamic Religious. By exploring the use of technology by teachers and students at Muhammadiyah Junior High School Special Program Kottabarat, Yogyakarta, this study offers practical insights into the benefits and challenges of integrating this technology in real-world educational best practices.

The findings of this study are expected to inform future practices and policies, encouraging the wider adoption of mirroring technology in religious education. By highlighting the practicality and impact of the use of this technology in Islamic Religious this research makes a valuable contribution to the educational technology literature and the field of religious education. A literature review shows that there are two main streams of relevant research: the use of digital technology in Islamic Religious Education Islamic Religious and the study of the implementation of wireless screen mirroring technology in education. The study on Islamic Religious emphasizes the importance of digital technology integration strategies to improve students' understanding and practice in schools, as well as highlighting the urgency of Islamic Religious teacher training in the use of ICT to create an adaptive learning ecosystem [2]. Other research shows that multimedia integration significantly improves the effectiveness of religious teaching and encourages a more interactive learning experience [50]. Specifically, in the context of technology, the implementation of screen mirroring on smartphones or other devices has been validated as an effective wireless presentation aid and reduces the mobility limitations of teachers due to cables [51], with an optimal distance between 1 to 7 meters. In addition, the mirroring technique which is interpreted as imitation behavior (NLP) is also mentioned in its relevance in the concept of *uswatun hasanah* in Islamic Religious, showing the existence of different dimensions of reflection and imitation of values [52].

This study contributes theoretically by extending Media Richness Theory into the context of technology-enhanced Islamic Religious Education. The findings indicate that the pedagogical value of media richness is not limited to the availability of multiple communication cues, but also lies in the capacity of technology to transform abstract religious content into multimodal, observable, and discussable learning representations. More importantly, the study integrates Media Richness Theory, Cognitive Theory of Multimedia Learning, and constructivist learning perspectives into a sequential explanatory mechanism. Mirroring technology first increases representational richness through the simultaneous presentation of visual, verbal, audio, and interactive resources. These representations support cognitive processing by enabling learners to connect multiple forms of information, while real-time sharing and shared visual attention facilitate discussion, collaboration, and meaning negotiation. The study therefore proposes the concept of mirroring-enabled pedagogical affordance, referring to the capacity of wireless screen mirroring to transform technological immediacy and multimodality into meaningful pedagogical interaction. This theoretical contribution shifts the interpretation of mirroring from a technical presentation device toward a pedagogical mechanism through which technological affordances are converted into cognitive, social, and instructional opportunities.

The existing research gaps were then filled by this study, which qualitatively examined how wireless mirroring technology is applied and impacts the interactivity and visualization of Islamic Religious materials at the high school level [53]. These results are in line with research that highlights the need for digital media innovation to make Islamic Religious learning more interactive, accessible, and engaging [54], [55]. Muhammadiyah Junior High School Special Program Kottabarat is one of the leading schools in Yogyakarta City. Address at Jl. Pleret Raya No.9 Kel. Banyuanyar Kec. Banjarsari, Purwosari, Kec. Laweyan, Kota Surakarta, Jawa Tengah. With superior manifestations in the form of technology optimization in learning activities and assessments by teachers reaching at least 95%. As well as increasing the competence and independence of teachers/employees in carrying out their main duties and functions based on information technology. Then with the position of school rankings based on the scores of the Computer-Based Written Examination (UTBK) at the district, provincial and national levels, namely the top 5 (five) at the district level, the top 10 (ten) at the provincial level and the top 60 (sixty) at the national level. Student achievements in the field of National Student Research Competition (KOPSI), National Student Innovation and Entrepreneurship Festival (FIKSI), National Student Sports Olympiad (O2SN), National Science Olympiad (OSN) and National Student Art Festival and Competition (FLSSN) every year [56]. This study reconceptualizes screen mirroring from a presentation technology into a pedagogical affordance that enables representational richness, shared visual attention, instructional immediacy, and collaborative meaning-making in religious education.

To strengthen the empirical context while retaining the qualitative case-study design, the study also presents two descriptive indicators of digital readiness. Nationally, 95.2% of secondary-school teachers are reported to use

gadgets, while technology optimization in learning activities and assessment at the research site is reported to reach at least 95%. These figures are used as contextual indicators of technological readiness and should not be interpreted as quantitative outcome measures of the present study.

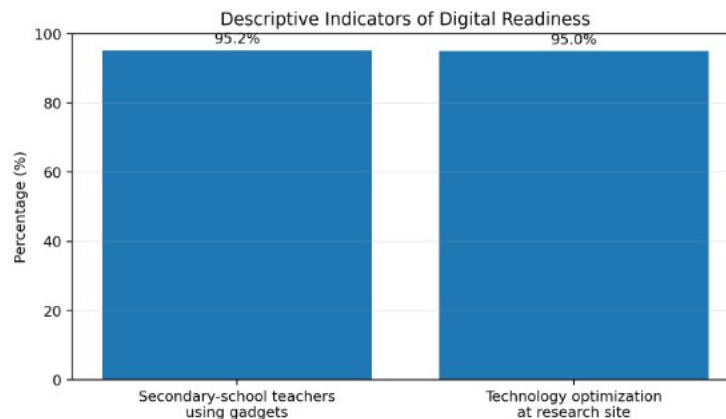


Figure 1. Descriptive indicators of digital readiness relevant to mirroring implementation.

Source: quantitative indicators reported in the manuscript. The 95.2% figure refers to national gadget utilization among secondary-school teachers, while the $\geq 95\%$ figure refers to technology optimization at the research site.

METHODS

This study employed a qualitative descriptive method with a single case study approach to explore the utilization of mirroring technology in Islamic Religious Education learning at Muhammadiyah Junior High School Special Program Kottabarat. A qualitative approach was chosen to obtain an in-depth understanding of the implementation process, classroom interactions, and the experiences of teachers and students in using mirroring technology during learning activities. The research site was selected purposively because the school has actively integrated digital technology into classroom instruction, particularly through the use of wireless screen mirroring to support interactive learning [49].

Data collection. Data were obtained through classroom observation, semi-structured interviews, and documentation. The observation protocol focused on four domains: (1) the type and function of digital resources displayed through mirroring; (2) teacher-student and student-student interaction; (3) observable forms of participation, attention, and collaborative activity; and (4) technical or pedagogical constraints during implementation. Semi-structured interviews explored participants' experiences of ease of use, instructional flexibility, student engagement, learning motivation, conceptual understanding, and implementation challenges. Documentation was used to corroborate observed practices and interview accounts, particularly in relation to learning materials, digital media, and classroom activities. Using three data sources enabled the researchers to compare what participants reported with what occurred during instruction [57].

Data analysis. The analysis followed the interactive logic of data collection, data reduction, data display, and conclusion drawing. First, observation records, interview data, and documentation were organized according to source and classroom context. Second, meaningful units were identified and coded according to recurring instructional and experiential patterns. Third, related codes were clustered into four analytical domains that correspond to the study findings: implementation of mirroring technology; student engagement and classroom interaction; learning motivation and meaningful learning; and supporting factors, challenges, and educational implications. Fourth, the coded material was compared across data sources and displayed in an analytical matrix to identify convergence, variation, and relationships among themes. Interpretive conclusions were then formulated only when they were supported by evidence across the available data sources. The collected data were analyzed using the interactive model of Miles and Huberman, which consists of data collection, data reduction, data display, and conclusion drawing. To ensure the credibility of the findings, the study applied source and method triangulation by comparing information obtained from observations, interviews, and supporting documents [58]. This approach enabled the researchers to produce a comprehensive description of how mirroring technology contributes to improving classroom interactivity, student engagement, and the effectiveness of Islamic Religious Education learning [59].

RESULTS AND DISCUSSION

Implementation of Mirroring Technology in Islamic Religious Education Learning

The findings indicate that the implementation of mirroring technology has substantially transformed instructional practices in Islamic Religious Education at Muhammadiyah Junior High School Special Program Kottabarat. The transformation is evident not only in the replacement of conventional projection systems but also in changes in how teachers organize learning resources, explain religious concepts, interact with students, and manage classroom activities. Wireless screen mirroring allows teachers to connect smartphones, tablets, and laptops directly to interactive flat panels without relying on fixed cable connections. This technical flexibility creates a more fluid instructional process in which digital resources can be accessed, displayed, changed, and discussed in real time [44], [45].

Before the integration of mirroring technology, classroom presentation tended to depend on predetermined materials prepared in presentation software and displayed through conventional projectors. Such an instructional format often positioned digital technology primarily as a presentation device. In contrast, the use of mirroring technology enables teachers to integrate multiple digital resources during the learning process. Teachers can respond directly to students' questions by opening relevant Qur'anic verses, digital tafsir, images, videos, maps, online references, or interactive applications. Consequently, digital content becomes part of the instructional interaction rather than a static supplementary resource.

This shift is important because Islamic Religious Education requires students to understand different forms of knowledge. Some learning materials emphasize factual and conceptual knowledge, such as Islamic history, Islamic jurisprudence, Qur'anic interpretation, and moral concepts. Other materials require procedural understanding, including prayer procedures, ablution, pilgrimage rituals, Qur'anic recitation, and the practical application of Islamic teachings. Mirroring technology provides teachers with greater opportunities to adjust the form of representation according to the characteristics of the subject matter.

During classroom implementation, teachers used mirroring technology to display digital Qur'an applications, tafsir references, presentation slides, instructional videos, online learning platforms, digital worksheets, interactive quizzes, images, and other web-based learning resources [42], [43]. This integration enabled teachers to combine textual, visual, auditory, and interactive materials within a single instructional sequence. For example, when discussing Qur'anic verses, teachers could simultaneously display Arabic text, translations, interpretations, and supporting visual materials. When students encountered unfamiliar vocabulary or contextual issues, teachers could directly open supplementary references without stopping the main learning activity.

The use of multiple digital resources also increased instructional flexibility. Teachers were able to move from one learning resource to another according to classroom conditions. A teacher could begin with presentation slides, continue with a Qur'anic application, display a short instructional video, and then conclude the lesson with an interactive quiz. The transition occurred without repeatedly changing devices or reconnecting cables. This technical efficiency reduced unnecessary interruptions and helped teachers maintain the continuity of classroom instruction [40].

The findings suggest that this flexibility has pedagogical significance. Efficient transitions between learning resources allow teachers to allocate more classroom time to explanation, discussion, questioning, reflection, and formative assessment. The main benefit of mirroring technology therefore does not lie solely in technological convenience. Its educational value emerges when technical efficiency supports more purposeful instructional activities. For procedural religious content, visual demonstrations allow students to observe the sequence and accuracy of religious practices. In the discussion of prayer, for instance, students can observe movement sequences, positions, and procedures through videos or digital visualizations. In pilgrimage-related materials, students can examine maps, images, simulations, and videos showing the spatial and procedural relationships between tawaf, sa'i, wuquf, and other rituals. These visual representations provide concrete reference points for concepts that students may not have experienced directly.

Similarly, historical materials can be strengthened through timelines, maps, photographs, and documentary videos. Instead of learning Islamic history mainly through chronological narration, students can connect events with geographical locations, social contexts, historical figures, and cultural developments. Such visualization can support a more contextual understanding of historical information.

The same function can be observed in learning topics related to Islamic morality. Although moral values are abstract by nature, teachers can use videos, digital narratives, case studies, images, or short scenarios to present situations involving honesty, responsibility, tolerance, discipline, social relationships, and digital ethics. Students can then analyze concrete situations and relate Islamic principles to everyday decision-making. Therefore, mirroring technology can support the movement from abstract moral concepts toward contextual moral reasoning.

These findings indicate that multimedia visualization can reduce students' dependence on exclusively verbal forms of explanation. Students receive information through multiple representational formats, including written text, images, audio, animations, videos, diagrams, and digital simulations [38]. Multiple representations are particularly important in subjects such as Islamic Religious Education because religious knowledge involves cognitive understanding, practical competence, value internalization, and behavioural application. The findings therefore demonstrate that mirroring technology functions as a pedagogical bridge between theoretical Islamic knowledge and practical religious understanding[40].

Another important finding concerns the visualization of abstract Islamic concepts. Islamic Religious Education contains numerous topics that require conceptual understanding beyond textual explanation, including prayer movements, pilgrimage rituals, Islamic history, inheritance calculation, and moral values [39], [41]. The availability of multimedia visualization through mirroring technology helped transform these abstract concepts into observable learning experiences. Students no longer depended exclusively on verbal explanations but were simultaneously exposed to images, animations, videos, and digital simulations that enhanced conceptual understanding [38].

This finding demonstrates that technology functions as a pedagogical bridge between theoretical Islamic knowledge and practical religious understanding[37]. Instead of simplifying religious content, mirroring technology enriches instructional communication by presenting multiple representations of knowledge. Consequently, students become more capable of connecting theoretical concepts with practical religious applications encountered in everyday life [36].

The present findings support Media Richness Theory [60], which argues that communication effectiveness depends on the richness of communication media. Mirroring technology provides immediate feedback, combines verbal and visual communication, facilitates natural interaction, and accommodates multiple communication cues simultaneously[34], [35]. These characteristics classify mirroring as a rich communication medium that is particularly appropriate for learning situations involving complex and abstract subject matter such as Islamic Religious Education[33], [61].

Furthermore, the implementation of mirroring technology reflects the broader digital transformation occurring within Indonesian secondary education. Technology is no longer viewed merely as supporting equipment but as an integral component of pedagogical innovation [32]. The successful implementation at Muhammadiyah Junior High School Special Program Kottabarat illustrates how digital infrastructure, teacher readiness, and institutional commitment collectively contribute to creating a technology-enhanced learning environment. This finding also confirms that effective digital transformation depends not only on technological availability but also on teachers' pedagogical competence in integrating technology meaningfully into classroom instruction[29], [30]. Its educational contribution does not result from simplifying Islamic content. Rather, the technology provides teachers with additional representational resources through which complex religious concepts can be explained more clearly. This distinction is important. Technology does not replace religious knowledge, teachers, textbooks, or direct religious practice. Instead, it expands the modes through which knowledge can be communicated and interpreted.

For example, understanding the concept of *amanah* requires more than memorizing its definition. Students need to recognize how responsibility operates within school activities, peer relationships, family life, and digital environments. Through mirroring technology, teachers can present real or simulated cases and encourage students to identify appropriate Islamic responses. Likewise, learning about worship requires students to understand both normative principles and practical procedures. Digital visualization can support this process by making procedural elements observable before students engage in direct practice.

Consequently, students are better positioned to connect theoretical religious concepts with situations encountered in everyday life [36]. This process indicates a transition from information-oriented learning toward contextual religious understanding. The educational significance of mirroring technology

therefore depends on how teachers use it to connect textual Islamic knowledge, visual representation, classroom dialogue, and practical reflection.

The findings can also be interpreted through Media Richness Theory [60]. The theory proposes that communication media differ in their capacity to convey information, provide immediate feedback, communicate multiple cues, and facilitate understanding of complex or ambiguous messages. Richer media are considered more appropriate for situations in which information requires clarification, interpretation, and interaction.

From this perspective, mirroring technology can be categorized as a relatively rich instructional medium because it integrates several communication characteristics. First, it facilitates immediate feedback because teachers can respond directly to student questions by displaying relevant digital resources. Second, it integrates multiple communication cues through text, images, sound, video, gestures, and verbal explanation. Third, it supports flexible interaction because teachers can change learning materials in response to classroom needs. Fourth, it allows complex information to be presented through multiple representations rather than through a single communication channel [34], [35]. These characteristics are especially relevant to Islamic Religious Education. Religious concepts often contain normative, historical, conceptual, procedural, and ethical dimensions simultaneously. A single verbal explanation may therefore be insufficient for students with different levels of prior knowledge and learning preferences. The richness of multimedia communication provides teachers with alternative ways of representing the same concept, which can reduce ambiguity and strengthen students' understanding

The following figures provide a visual summary of the findings in each discussion subsection. The values represent the number of thematic elements or examples explicitly identified in the discussion, so they function as analytical visualizations rather than statistical outcome measures.

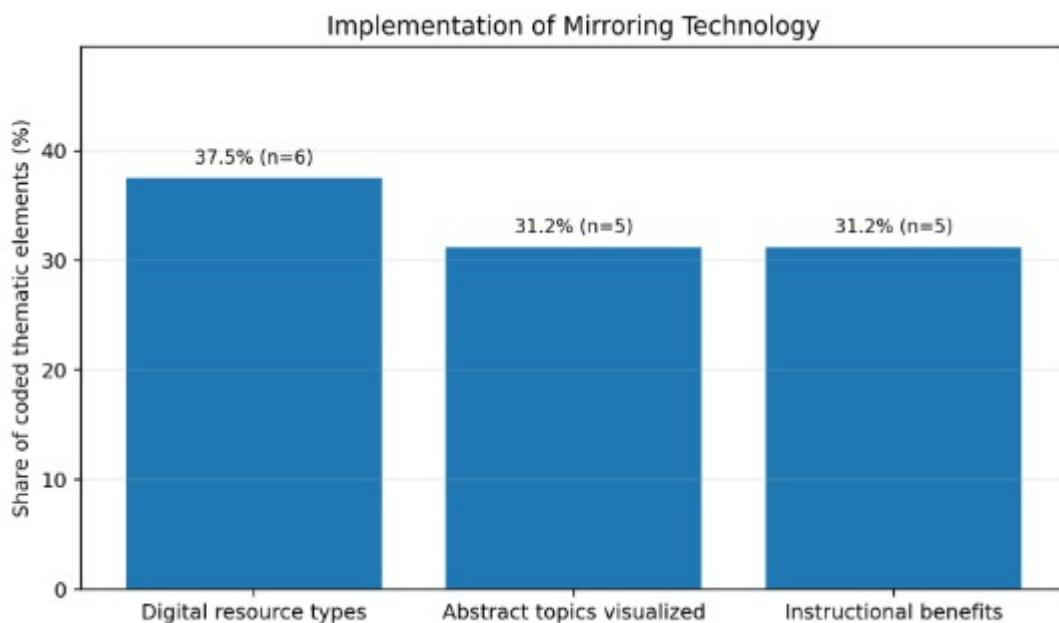


Figure 2. Visual summary of the implementation of mirroring technology.

Note: Counts are derived from the thematic elements explicitly reported in the manuscript; they are intended as visual summaries of qualitative findings.

Student Engagement and Classroom Interaction

One of the most prominent findings of this study concerns the increase in student engagement and the transformation of classroom interaction following the integration of mirroring technology into Islamic Religious Education learning. The findings indicate that students became more actively involved in the instructional process, particularly through classroom discussions, question-and-answer activities, peer collaboration, interpretation of digital learning materials, and spontaneous responses to visual content presented on the interactive display. Students demonstrated greater willingness to answer teachers' questions,

express their opinions, provide examples from their own experiences, respond to classmates' ideas, and participate in collaborative learning activities [25], [31]. This pattern represents an important change in classroom dynamics. In more conventional learning situations, instructional communication frequently followed a teacher-dominated pattern in which teachers explained the material while students primarily listened, took notes, and responded when directly asked. After mirroring technology was integrated into classroom activities, interaction became more multidirectional. Communication no longer occurred exclusively from teacher to student but also developed between students, between students and digital learning resources, and between students and the broader classroom group [24], [26]

This shift indicates a gradual movement from a transmission-oriented instructional model toward a more participatory and student-centred learning environment. The increased engagement was particularly visible when teachers presented visual and interactive materials. Digital visualization appeared to stimulate students' curiosity and create stronger initial attention toward the subject matter [22], [23]. Compared with text-based explanations alone, visual materials provided additional stimuli that encouraged students to observe, compare, interpret, and question what they saw. Videos, photographs, animations, diagrams, digital Qur'anic resources, and illustrations provided concrete reference points that made classroom discussion easier to initiate.

For example, when students observed videos demonstrating religious practices, they were able to identify specific movements, procedures, or situations and immediately ask questions regarding their correctness, meaning, or relevance. Similarly, visual representations of Islamic historical events, religious rituals, or ethical situations encouraged students to compare the displayed content with their existing knowledge and personal experiences. These activities generated questions that may not have emerged from verbal instruction alone.

The findings suggest that visual learning materials functioned as **interaction triggers**. Their role was not limited to attracting students' attention. Visual resources also created common objects of observation that could be interpreted collectively by teachers and students. When an image, video, diagram, or digital text was displayed on the classroom screen, students shared the same visual reference. This shared reference made it easier for them to comment, ask questions, challenge interpretations, or connect the content with previous lessons.

This mechanism is particularly relevant in Islamic Religious Education because many learning topics involve interpretation and application rather than simple memorization. Concepts such as honesty, responsibility, tolerance, social ethics, religious moderation, worship practices, and Islamic moral conduct require students to examine situations and determine how religious principles should be applied. Digital visual materials can present contextual cases that encourage students to move from recalling religious concepts toward analysing their practical implications.

For instance, a teacher discussing Islamic ethics could display a short scenario related to digital communication, friendship, honesty, bullying, environmental responsibility, or social media behaviour. Students could then be asked to identify relevant Islamic values, evaluate the actions presented in the scenario, and propose alternative responses. Through this process, digital visualization becomes a stimulus for moral reasoning and reflective discussion rather than merely an instructional decoration.

The increased classroom interaction was also influenced by the technical flexibility provided by mirroring technology. Teachers could immediately display students' work, digital notes, online references, mind maps, educational applications, or other learning products directly from smartphones, tablets, or laptops [19]. This immediacy reduced the distance between student-generated content and whole-class discussion.

When student work could be displayed instantly, the classroom became more responsive to learners' contributions. Teachers could use a student's response as a discussion point, compare different answers, provide formative feedback, or invite classmates to evaluate a particular idea. Student contributions therefore became visible instructional resources rather than private work assessed only by the teacher.

This visibility appears to have strengthened students' sense of participation. When students recognize that their ideas may become part of classroom discussion, they are more likely to perceive themselves as contributors to the learning process. The classroom therefore changes from a space in which knowledge is delivered by teachers into a learning community in which knowledge can be examined, discussed, and refined collaboratively.

The findings also reveal that mirroring technology supported spontaneous classroom interaction. In conventional technology settings, displaying additional resources may require teachers to change devices, connect cables, search for files, or interrupt the instructional flow. Wireless mirroring minimizes these technical interruptions. Teachers can respond immediately to classroom developments by displaying relevant material when a question or issue emerges.

Such responsiveness is pedagogically significant because meaningful classroom interaction cannot always be predicted in advance. Students may raise unexpected questions, relate the topic to current experiences, or misunderstand a concept in ways that require immediate clarification. The ability to present supporting visual evidence, additional references, or alternative explanations enables teachers to respond more effectively to these emerging learning needs.

As a result, classroom instruction becomes less rigid and more dialogic. Teachers retain responsibility for guiding the learning process, but they can adjust the instructional sequence according to student responses. This flexibility supports what can be described as **responsive pedagogy**, in which instructional decisions are continuously adjusted based on learners' questions, participation, and understanding.

Another important finding is the transition from passive reception toward active knowledge construction. Students were not positioned merely as recipients of information. Instead, they became participants in the interpretation and discussion of learning materials. Through dialogue, observation, questioning, comparison, and collaborative problem-solving, students contributed to constructing shared understanding [17], [18].

This process can be illustrated in several stages. First, students encounter a visual or digital stimulus. Second, they interpret the information based on their existing knowledge. Third, students express questions or opinions. Fourth, these ideas are discussed with teachers and peers. Finally, students refine their understanding through explanation, feedback, comparison, and reflection. In this sequence, learning occurs through active engagement with both content and social interaction.

From a pedagogical perspective, these findings align strongly with constructivist learning theory. Constructivism views learners as active participants who develop understanding through interaction with information, prior experience, social contexts, and other individuals. Knowledge is not simply transferred from teacher to student. Learners interpret new information by connecting it with existing cognitive structures and reconstructing their understanding through experience and reflection.

Within this framework, mirroring technology functions as a mediating tool rather than an independent source of learning. The technology provides a shared digital environment in which information can be displayed, questioned, interpreted, and discussed. Its educational value emerges through the interactions that occur around the displayed content. This finding is also consistent with the social constructivist perspective, which emphasizes the role of social interaction in learning. Students often deepen their understanding when they explain ideas to others, listen to different perspectives, negotiate interpretations, and collectively solve problems. Classroom dialogue therefore becomes a central mechanism of knowledge construction rather than merely an additional instructional activity.

In Islamic Religious Education, this mechanism has particular importance because religious understanding often requires interpretation, reflection, and contextual application. Students may understand a religious concept differently depending on their prior experiences, family environments, social contexts, and levels of religious knowledge. Collaborative discussion enables these interpretations to be articulated and examined under the guidance of the teacher. Mirroring technology facilitates this process by creating a common visual and informational reference around which discussion can occur [14]. Students can observe the same text, image, video, or case simultaneously and then compare their interpretations. The teacher can guide the discussion, clarify misconceptions, connect students' responses with Islamic principles, and encourage deeper reflection.

The findings therefore indicate that technology contributes not only to cognitive engagement but also to social and communicative dimensions of learning. Students practise expressing ideas clearly, listening to others, responding to different viewpoints, defending arguments, asking relevant questions, and reaching shared conclusions. These skills represent important components of communication competence and collaborative learning [20], [21].

Three interrelated dimensions of student engagement can be identified from these findings. The first is **behavioural engagement**, reflected in students' increased participation in discussions, questioning, collaborative tasks, and classroom responses. The second is **cognitive engagement**, demonstrated through interpretation, comparison, problem-solving, and attempts to connect digital content with religious concepts. The third is **social engagement**, visible in peer interaction, collaborative meaning-making, and collective discussion.

These dimensions are important because student engagement should not be interpreted merely as visible enthusiasm or classroom activity. A student may appear active without necessarily engaging deeply with the learning content. The present findings suggest that mirroring technology can support deeper forms of engagement when visual and interactive resources are combined with purposeful questioning, discussion, reflection, and collaborative tasks.

The role of the teacher remains central in this process. Technology itself does not automatically produce active participation. Teachers need to design learning activities that invite student responses. For example, showing an instructional video without follow-up questions may only change the format of passive learning. In contrast, asking students to identify key ideas, evaluate a situation, compare perspectives, solve problems, or formulate conclusions transforms the same video into a stimulus for active learning.

Therefore, the effectiveness of mirroring technology depends on the interaction between technological affordances and pedagogical strategies. The technology offers immediacy, visibility, flexibility, and multimedia presentation. Teachers convert these affordances into meaningful engagement through appropriate instructional design. The findings also suggest that questioning strategies are particularly important. Teachers can use digital content as a basis for higher-order questions such as "Why does this occur?", "What Islamic principle is relevant to this situation?", "How would you respond if you encountered this situation?", "What is the difference between these two examples?", or "What evidence supports your interpretation?". Questions of this type require students to analyse, evaluate, connect, and apply knowledge rather than simply recall factual information.

In this context, mirroring technology can facilitate the transition from lower-order cognitive activities toward higher-order thinking. Visual cases and digital scenarios provide concrete material for analysis, while classroom discussion allows students to articulate their reasoning. This combination may strengthen the intellectual dimension of Islamic Religious Education by positioning students as interpreters and problem-solvers [19]. Such immediacy created opportunities for spontaneous classroom discussion and collaborative problem-solving. Instead of passively receiving information, students became active participants in constructing knowledge through dialogue and shared exploration [17], [18].

From a pedagogical perspective, this finding aligns with constructivist learning theory, which emphasizes active learner participation in knowledge construction. Mirroring technology functions as a mediating tool that facilitates collaborative learning, enabling students to negotiate meaning through visual interaction, discussion, and reflection [14]. Consequently, technology contributes not only to cognitive development but also to communication skills and collaborative competence. Another important aspect concerns collaborative learning. The findings indicate that students were more willing to collaborate when digital content became part of group activities. Teachers could display a problem, case, image, question, or task for the entire class and then ask students to work in small groups before sharing their conclusions.

Group responses could subsequently be mirrored to the classroom display and discussed collectively. Such practices create a sequence of individual interpretation, peer discussion, public presentation, and collective feedback. This structure encourages accountability because students know that their ideas may be shared with the wider class. The display of student-generated work also creates opportunities for peer learning. Students can compare their answers with those of other groups and recognize alternative approaches. Differences between responses can become productive sources of discussion. Instead of treating different answers exclusively as errors, teachers can use them to explore reasoning processes, clarify concepts, and strengthen understanding.

The findings therefore support the notion that mirroring technology can contribute to the creation of a **participatory digital classroom**. In such a classroom, digital technology does not simply deliver content from the teacher's device to the screen. It creates a shared interface through which teachers and students contribute to the instructional process [15], [16].

These findings extend previous studies demonstrating that multimedia learning environments improve classroom engagement [12]. While earlier research primarily focused on mathematics, science, and language education, the present study provides evidence that similar pedagogical benefits are also applicable within Islamic Religious Education. The findings also provide evidence of changes in teacher-student relationships during instruction. Greater opportunities for students to ask questions, share ideas, and display their work contributed to more interactive communication. Teachers became less exclusively positioned as lecturers and increasingly functioned as facilitators who guided classroom inquiry and discussion.

This does not imply a reduction in teacher authority. In Islamic Religious Education, teachers retain an important role in ensuring conceptual accuracy, religious legitimacy, and appropriate interpretation. However, authority can coexist with participatory learning. Teachers can maintain academic and religious guidance while creating greater space for student inquiry and dialogue. This balance is important because excessive teacher control may limit students' opportunities to develop independent reasoning, whereas completely unguided discussion can produce misconceptions. Mirroring technology can support a guided participatory model in which students actively explore learning materials while teachers provide conceptual scaffolding and corrective feedback.

This process is consistent with the concept of scaffolding in constructivist learning. Teachers can provide temporary support through explanations, prompts, visual materials, guiding questions, examples, and feedback. As students develop greater understanding, the level of teacher support can gradually decrease. Mirroring technology supports this scaffolding process because teachers can quickly adjust the type of support provided. If students have difficulty understanding a concept, the teacher can display an additional diagram, example, video, or explanatory source. If students demonstrate adequate understanding, the teacher can move toward more complex tasks requiring analysis or application.

Therefore, technology facilitates adaptive interaction within the classroom. Teachers can respond to differences in student understanding without necessarily interrupting the overall learning process. This flexibility may be particularly valuable in classrooms with diverse levels of prior knowledge.

These findings extend previous research indicating that multimedia learning environments can improve student engagement and participation [12]. Earlier studies have frequently examined such effects in mathematics, science, language learning, and general educational contexts. The present study demonstrates that similar mechanisms also operate within Islamic Religious Education[9], [13]. Therefore, technology integration should not be perceived as conflicting with religious instruction but rather as strengthening its educational effectiveness [8], [10].

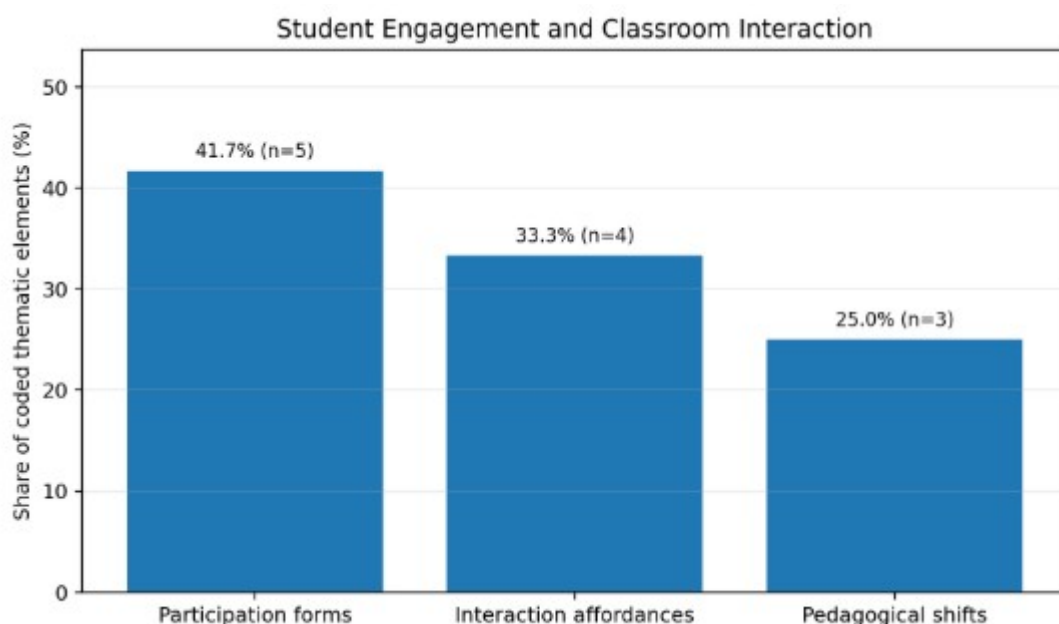


Figure 3. Visual summary of student engagement and classroom interaction.

Note: Counts are derived from the thematic elements explicitly reported in the manuscript; they are intended as visual summaries of qualitative findings.

Learning Motivation and Meaningful Learning Experience

Another important finding concerns the role of mirroring technology in shaping students' learning motivation and meaningful learning experiences in Islamic Religious Education. The findings suggest that integrating wireless screen mirroring created a learning environment perceived as more engaging, enjoyable, and relevant to students' everyday digital experiences[3], [27]. The classroom practices reported in this study illustrate how teachers combined digital Qur'anic applications, instructional videos, audio recordings, and interactive learning materials to support student attention and participation. These practices suggest that the motivational potential of mirroring technology lies not simply in the novelty of digital devices but in how teachers organize multimodal instructional experiences [11], [62], [63]

Empirical evidence from classroom implementation indicates three interconnected patterns of motivational engagement: attentional engagement, behavioural participation, and learning persistence. First, students demonstrated greater concentration during technology-supported learning activities. Second, classroom interaction was characterized by students' willingness to answer questions, express opinions, and participate in discussions. Third, students appeared more willing to complete collaborative learning assignments. Although these findings do not establish statistically significant changes in motivation, they provide qualitative indications that technology-supported instructional practices may create conditions conducive to student engagement.

A particularly relevant example emerged in Qur'anic learning activities. During these lessons, teachers integrated Arabic texts, recitation audio, pronunciation videos, and verbal explanations within a shared instructional display. This approach enabled students to encounter religious learning content through complementary representational formats rather than relying exclusively on textual explanations. The integration of written Qur'anic passages, auditory recitation, and visual pronunciation demonstrations illustrates how mirroring technology facilitates multimodal access to religious knowledge. Such instructional arrangements may help learners connect the written forms of Arabic expressions with their corresponding sounds and pronunciation practices.

These findings can be interpreted through the **Cognitive Theory of Multimedia Learning**, which emphasizes the integration of verbal and pictorial information within cognitive processing. From this perspective, mirroring technology provides opportunities for learners to construct meaningful connections between different representations of instructional content. However, multimedia presentation does not automatically enhance comprehension. Its educational value depends on instructional coherence, appropriate information sequencing, and the prevention of unnecessary cognitive load. In Qur'anic learning, the simultaneous presentation of Arabic text, recitation audio, pronunciation demonstrations, and teacher guidance may support meaningful processing when teachers coordinate these resources according to learners' cognitive capacities. Meaningful learning occurred because students experienced multiple forms of representation simultaneously. During Qur'anic learning, for example, students observed Arabic texts, listened to recitation audio, watched pronunciation videos, and received teachers' explanations concurrently. Such multimodal instruction strengthened comprehension by engaging multiple sensory channels [64], [65], [66]. **Empirical evidence from classroom implementation indicates three interconnected patterns of motivational engagement: attentional engagement, behavioural participation, and learning persistence.** First, students demonstrated greater concentration during technology-supported learning activities. Second, classroom interaction was characterized by students' willingness to answer questions, express opinions, and participate in discussions. Third, students appeared more willing to complete collaborative learning assignments. Although these findings do not establish statistically significant changes in motivation, they provide qualitative indications that technology-supported instructional practices may create conditions conducive to student engagement.

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Table 1. Sintetis Teori

Empirical indicator	Evidence reported in manuscript	Analytical interpretation
Attentional engagement	Students demonstrated greater concentration during learning activities	Behavioural indication of attention
Classroom participation	Students answered questions, expressed opinions, and joined discussions	Active behavioural engagement
Learning persistence	Students appeared more willing to complete collaborative assignments	Possible indication of task persistence
Multimodal representation	Arabic text, recitation audio, pronunciation videos, and teacher explanations were combined	Opportunity for verbal and visual knowledge integration
Collaborative learning	Digital resources and student work supported classroom discussion	Opportunity for social meaning-making

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The motivational dimension can also be interpreted through **Self-Determination Theory**, particularly the psychological needs for competence, autonomy, and relatedness. Interactive digital resources may support perceived competence by making instructional explanations more accessible. Opportunities to discuss displayed materials and complete collaborative tasks may strengthen relatedness through classroom interaction. However, the available evidence does not establish whether students experienced greater autonomy or whether their intrinsic motivation increased. These relationships therefore remain theoretically plausible interpretations requiring direct investigation.

An important empirical distinction concerns the relationship between technological engagement and meaningful learning. The study reports that students displayed greater concentration and willingness to participate during lessons supported by mirroring technology. Nevertheless, these behavioural indicators should not be treated as equivalent to demonstrated conceptual understanding or long-term knowledge retention. Meaningful learning requires students to integrate new knowledge with existing cognitive structures and apply their understanding in relevant situations. Consequently, evidence of active participation provides an indication of engagement but cannot independently establish improvements in religious knowledge acquisition or retention.

Taken together, the findings support a preliminary interpretation of **mirroring-enabled motivational affordance**, in which the instructional use of multimodal representations and shared digital resources creates opportunities for attention, participation, and collaborative learning. This interpretation extends the discussion beyond the assumption that digital technology inherently motivates students. Instead, it emphasizes the role of teacher-mediated instructional design in translating technological capabilities into potentially meaningful learning experiences.

The contribution of this finding lies in identifying a possible relationship between **multimodal religious knowledge representation, classroom engagement, and meaningful learning opportunities**. Within the proposed affordance-to-pedagogy framework, mirroring technology provides representational flexibility, while teachers organize these resources to support cognitive processing and social participation. The findings suggest that meaningful integration requires more than access to interactive technology; it depends on how digital representations, classroom dialogue, and instructional objectives are coordinated within religious learning activities. According to Cognitive Theory of Multimedia Learning, combining visual and verbal

information enables learners to process information more efficiently within working memory. Consequently, mirroring technology contributes not only to attracting students' attention but also to improving long-term knowledge retention[67], [28], [68]

Moreover, increased motivation influenced classroom discipline and learning persistence. Students demonstrated greater concentration throughout instructional activities and appeared more willing to complete collaborative assignments. These behavioural changes indicate that technology contributes to creating a more positive learning climate [6], [7], [69]

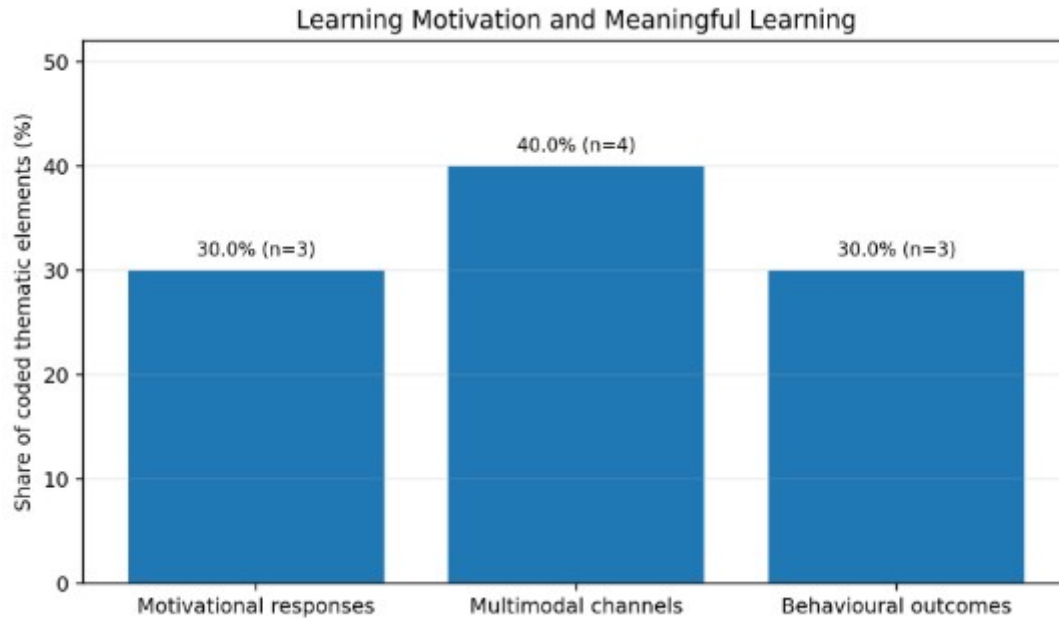


Figure 4. Visual summary of learning motivation and meaningful learning experience.

Note: Counts are derived from the thematic elements explicitly reported in the manuscript; they are intended as visual summaries of qualitative findings.

Supporting Factors, Challenges, and Educational Implications of Mirroring Technology

The implementation of mirroring technology in Islamic Religious Education at Muhammadiyah Junior High School Special Program Kottabarat was supported by several interrelated factors, including strong institutional commitment to digital transformation, adequate technological infrastructure, teachers' digital competence, and students' readiness to engage with technology-based learning [4], [5]. The availability of interactive flat panels, wireless internet connectivity, and digital learning resources enabled teachers to integrate multimedia content into classroom instruction more effectively. Moreover, teachers' willingness to adopt innovative teaching strategies and students' familiarity with digital devices facilitated a smoother learning process and enhanced classroom interaction. These findings indicate that successful technology integration is influenced not only by infrastructure but also by the digital readiness of teachers and learners[70], [71].

Despite these positive outcomes, several challenges remained, including unstable internet connectivity, device compatibility issues, and variations in teachers' technological and pedagogical competence. In some cases, mirroring technology was still utilized primarily as a presentation tool rather than as an interactive learning medium[72], [73]. These findings suggest that the effectiveness of digital transformation depends on continuous professional development that strengthens teachers' digital pedagogical skills alongside investments in technological infrastructure. Overall, the study demonstrates that mirroring technology has considerable potential to improve communication, student engagement, learning motivation, and conceptual understanding in Islamic Religious Education, while emphasizing the importance of sustainable institutional support and teacher capacity development to maximize its educational impact[74], [75].

The novelty of this study lies not merely in examining screen mirroring within Islamic Religious Education, but in empirically identifying the pedagogical mechanism through which mirroring transforms technological affordances into learning affordances. Classroom observations showed that teachers used mirroring to display digital Qur'an applications, tafsir references, instructional videos, online learning platforms, presentation slides, and interactive quizzes directly from smartphones, tablets, and laptops. This

real-time switching between digital resources enabled teachers to move beyond static projection and create a more flexible instructional environment. The empirical findings further revealed that abstract and text-dominant religious topics, including prayer movements, pilgrimage rituals, Qur'anic texts, Islamic history, inheritance calculation, and moral concepts, were represented through images, audio, video, animation, and digital simulation. This process represents what this study conceptualizes as representational transformation, in which religious knowledge shifts from predominantly textual-verbal forms into shared, multimodal, and observable representations.

The empirical data also indicate that these representational changes were accompanied by changes in classroom interaction. Students were observed to participate more actively in discussions, answer questions, express opinions, ask questions, and collaborate with peers. Teachers were also able to display students' work, digital mind maps, online references, and educational applications directly on the shared screen, creating opportunities for spontaneous discussion and collaborative problem-solving. In addition, multimodal Qur'anic learning combined Arabic text, recitation audio, pronunciation videos, and teacher explanation within the same instructional episode. These patterns suggest that mirroring does not merely increase media richness but creates shared visual attention and collective meaning-making. Based on these findings, this study proposes the concept of mirroring-enabled pedagogical affordance to explain how technological immediacy, multimodality, and content mobility are converted into cognitive and social opportunities for learning.

A further contribution is the identification of boundary conditions. The findings show that the pedagogical value of mirroring is not automatic. Unstable internet connectivity, device compatibility problems, differences in teachers' digital-pedagogical competence, and the tendency to use mirroring merely as a presentation tool constrained its instructional potential. These empirical conditions refine the proposed affordance-to-pedagogy framework by showing that technological affordances generate pedagogical value only when they are supported by adequate infrastructure, teacher competence, institutional commitment, and purposeful instructional design.

Table 1. Research Summary Table

Empirical Evidence	Identified Mechanism	Conceptual Interpretation	Novel Contribution
Digital Qur'an, tafsir, videos, slides, quizzes displayed in real time	Content mobility and immediacy	Media richness	Mirroring as pedagogical affordance
Prayer, pilgrimage, Qur'anic texts, history, moral concepts visualized	Representational transformation	Multimedia cognition	Abstract religious knowledge becomes observable
Students ask, answer, discuss, express opinions, and collaborate	Shared visual attention and interaction	Constructivist learning	Mirroring facilitates collective meaning-making
Arabic text + audio + video + teacher explanation	Multimodal cognitive processing	CTML	Religious learning becomes multimodally mediated
Student work and digital mind maps displayed instantly	Collaborative knowledge construction	Social constructivism	Mirroring supports student-centred interaction
Internet instability, compatibility issues, varied teacher competence	Boundary conditions	Technology integration constraints	Affordance does not automatically produce learning value

CONCLUSION

This study concludes that the utilization of mirroring technology has become an effective instructional innovation for enhancing the quality of Islamic Religious Education learning at Muhammadiyah Junior High School Special Program Kottabarat. The integration of wireless screen mirroring enables teachers to present learning materials in a more interactive, flexible, and visually engaging manner, thereby improving classroom communication, student participation, learning motivation, and conceptual understanding of both abstract and practical Islamic topics. These findings reinforce the perspective of Media Richness Theory, which suggests that communication media with higher richness are more effective in facilitating the delivery of complex learning content through the integration of visual, verbal, and interactive elements.

The study also identifies that the successful implementation of mirroring technology depends not only on the availability of technological infrastructure but also on institutional support, teachers' digital competence, and students' readiness to participate in technology-enhanced learning. Nevertheless, several challenges remain, including technical limitations and variations in teachers' pedagogical skills in utilizing digital media effectively. Therefore, schools should strengthen sustainable digital infrastructure while providing continuous professional development to improve teachers' digital pedagogical competence. Future research is recommended to investigate the long-term impact of mirroring technology on students' learning outcomes, digital literacy, and religious character development through broader samples and mixed-method or quantitative research designs.

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